BAMSF
EVMSF
HNMSF
12,1 v4

DATA QUALITY ASSESSMENT – PRE-2004 DATA
1999-2000 ELK TISSUE SAMPLES
TECHNICAL MEMORANDUM

Draft

Revision 1

October 30, 2009

Prepared by:

MWH AMERICAS, INC.

Prepared for:

P4 PRODUCTION, LLC

TABLE OF CONTENTS

1.0 Introduction and Purpose 1

2.0 Background for the 1999-2000 Elk Muscle and Liver Tissue 1

3.0 Addressing Other Identified Concerns Prior to 4-Step Assessment 2

3.1 Addressing A/T Concern Regarding Incomplete Data Packages from the UIASL 2

3.2 Addressing A/T General Observation for Samples with Non-Standard Matrices 9

4.0 Addressing Next Steps to Complete an Assessment of the Pre-2004 Data 10

4.1 Determine Data Needs 10

4.2 Screen Data for Use 13

5.0 Path Forward 16

6.0 References 17

LIST OF TABLES

Table 1 – Detailed Evaluation of UIASL Data package Content

Table 2 – Elk Tissue Data Quality Objectives

Table 3 – Screening Summary for the 1999-2000 Elk Tissue Data

ATTACHMENTS

Attachment A – MWH EDD – 1999-2000 Elk Tissue Data

Attachment B – UIASL SOPs

Attachment C – Screening Values for Metals in Tissues of Wild Game

1.0 Introduction and Purpose

A significant amount of data associated with the P4 Production, LLC (P4) Southeast Idaho Mines was collected between 1998 and 2003, collectively referred to as the "pre-2004 data." P4 has summarized the sampling and analysis efforts related to the collection of these data in the document titled *Pre-2004 Documents and Data Review and Summary for the Historic P4 Production Phosphate Mines, Caribou County, Idaho* (MWH, 2008). The Agencies and Tribes (A/T) have requested additional information to complete an assessment of quality as described in the *Proposed "Roadmap" for Completing an Assessment of the Quality of the Pre-2004 Data for P4 Production, LLC Mines in Southeast Idaho* (dated May 18, 2009), hereafter referred to as the Roadmap.

The purpose of this technical memorandum is to assess the quality of these existing analytical datasets to ensure that the type and quality of the data are appropriate for their intended end use. The intended end use for the elk muscle and liver tissue data includes qualitative and potentially quantitative evaluation in human health and ecological risk assessments. The data evaluation process described herein is consistent with the *Guidance for Quality Assurance Project Plans, QA/G-5* (USEPA, 2002) as referenced in the Roadmap. This technical memorandum specifically addresses the elk muscle and liver tissue collected in 1999 and 2000. Future technical memoranda will address other datasets.

The Roadmap provides direction for the "Next Steps to Complete an Assessment of the Pre-2004 Data." The four steps are consistent with the EPA QA/G-5 guidance. This technical memorandum addresses the first two steps: (1) determine data needs, and (2) screen data for use. P4 is seeking concurrence from the A/T with the data quality assessment provided in this technical memorandum for the elk muscle and liver tissue data prior to proceeding with the last two steps: (3) validate data, and (4) document data quality.

2.0 Background for the 1999-2000 Elk Muscle and Liver Tissue

The 1999 and 2000 elk study was a cooperative effort between the Selenium Committee and the Idaho Department of Fish and Game (IDFG). The Monsanto Company was one of six member companies of the Selenium Committee. IDFG collected elk skeletal muscle and liver tissues from hunters who harvested elk in game management units 66A and 76. The collection stations were erected near the P4 plant on Highway 34, just north of Soda Springs, and on Lower Georgetown Canyon Road near Georgetown, which overlap the central and eastern portions of the Resource Area (that is, the phosphate mines in southeast Idaho).

The Selenium Committee coordinated the analysis of the tissue samples at the University of Idaho Analytical Services Laboratory (UIASL or U of I). The purpose of the study was to determine if levels of the targeted trace elements (i.e., cadmium, copper, iron, lead, manganese, molybdenum, selenium and zinc) were elevated as a result of increased exposures related to phosphate mining, and, if so, to quantify any threat posed to human health. The information was also to be used, to the extent possible, to evaluate any threat to the health of the elk themselves (MW, 2000).

The elk tissue collection effort was planned and conducted according to the *1999-2000 Regional Investigation Sampling and Analysis Plan, Southeast Idaho Phosphate Resource Area Selenium Project* (MW, 1999). The results were presented and evaluated in the *1999 Interim Investigation Data Report, Southeast Idaho Phosphate Resource Area Selenium Project* (MW, 2000). Appendix H of the report summarizes the 1999 Elk Study Data. The 2000 elk data have not been presented in a formal report. MWH has the Certificates of Analysis (COAs) for all of the samples collected in 1999 and 2000, and all associated preparation log reports, "Quality Control" reports, raw instrument data, and electronic data deliverables.

3.0 Addressing Other Identified Concerns Prior to 4-Step Assessment

Subsequent to submitting the *Pre-2004 Documents and Data Review and Summary for the Historic P4 Production Phosphate Mines, Caribou County, Idaho* (MWH, 2008), the A/T requested P4 to assess completeness of data packages from a representative subset of pre-2004 data packages from all project laboratories using the content items identified by the A/T. This effort was documented in the table titled "Pre-2004 Data Package Content Assessment, Selected Data Packages." Based on that assessment, the UIASL data packages appeared to be incomplete when compared to the more comprehensive data packages provided by the two commercial laboratories. Additionally, Item No. 2 on page 2 of the Roadmap identified a specific concern regarding non-standard matrices. P4's responses to these concerns are provided in Sections 3.1 and 3.2.

3.1 Addressing A/T Concern Regarding Incomplete Data Packages from the UIASL

The content items listed in the table titled "Pre-2004 Data Package Content Assessment, Selected Data Packages" are listed (as applicable to ICP) in Table 1 below. The information provided in Table 1 provides a more detailed assessment of the UIASL data packages. Please note the content items specified by the A/T are based on standards developed by the USEPA Contract Laboratory Program (CLP), SW-846, and National Environmental Laboratory Accreditation Conference (NELAC). For example, "Form 1 equivalent" is a specific reference to the CLP field/laboratory sample results page and has required data fields. The information listed in Table 1 is an attempt to provide a map to or summary of where the data in the specific content item can be found in the documentation provided by UIASL. The CLP forms (or equivalent) were developed to provide a summary of the relevant data or information from the laboratory SOPs; chain-of-custody, sample-receipt, and preparation log documents; and instrument data. A summary presentation of these data is helpful in the ease-of-review of the data, but the absence of summary forms does not preclude the results from being reviewed or validated. Additionally, Table 1 provides a response to the quality control (QC) samples listed by the A/T as needed for completeness but that were not performed by UIASL (e.g., serial dilutions, interference check standards).

Add pre-amble

Table 1. Detailed Evaluation of UIASL Data Package Content

Content Item	Description/Comment	Assessment/Implication
Table of Contents, pagination, sample summary (a cross-reference of field and laboratory identifications)	These items are needed for ease of use for data reviewers and validators; having them saves time in navigating the data. MWH has reconstructed the data packages and assembled preparation and analytical batching key as presented in a more detailed electronic data deliverable (EDD or the "MWH EDD") provided as Attachment A. A cross reference of laboratory and field IDs is provided in log-in sheets.	MWH has prepared a more detailed EDD, the validators will be able to more quickly validate the data.
Case Narrative	A case narrative was not provided. The cover sheet to the sample data is presented on UIASL letterhead and titled "Certificate of Analysis." The cover sheet has laboratory personnel initials and dates for "1st Level QC" and "2nd Level QC."	The case narrative provides the reviewer with a "heads up," which gives them an idea of what to expect, but the lack of a case narrative does not prevent a validator from accurately validating the data.
Laboratory Log-in Forms	The log-in form documents the condition of samples upon receipt at the laboratory. UIASL log-in sheets note Animal #, Sample ID, organ (muscle or liver), total weight of organ, laboratory ID, UIASL Case #, and date of sample receipt.	The laboratory log-in form appears to be complete for the 1999-2000 elk tissue samples.
Chain-of-Custody Forms	Chains-of-custody documents are typically initiated by the sampler. In this case, the hunters initiated the collection form provided in Appendix C of the report (MW, 2000). MWH then assembled the field IDs onto chains for submittal to laboratory. The chains-of-custody for the elk samples do not list date and time of sample collection, but the forms completed by the hunters do.	Custody is maintained from collection by the hunters to receipt by P4/MWH. P4/MWH prepared chain-of-custody documents and submitted to UIASL for receipt.
Form 1 equivalent [a]	Form 1 requires the following items: Lab Name, SDG No., Matrix, Lab Sample ID, Date Received, % solids, units, CAS No., Analyte, Concentration, and detection limit. Results are reported on a wet-weight basis.	The Lab Name, SDG No., Matrix, Lab Sample ID, Date Received; % solids (or moisture content), units, Analyte, Concentration, and estimated detection limits (EDLs) or method detection limits (MDLs) are provided in UIASL "Certificate of Analysis" (COA) data packages (or "Case #"). CAS are not listed on the COA but are provided in the MWH EDD.
Method or Preparation Blank Results	Reagent (or instrument) blanks were prepared with all the acids used to digest the samples prepared with a given batch; however, the reagent blanks were not digested. Reagent blanks were prepared and analyzed at a rate or frequency of 10% of samples.	The reagent/instrument blanks would provide all of the same information (that is, identification or presence of acid or glassware contamination) as a method or preparation blank. Blanks are clearly associated on preparation log sheets and raw

Content Item	Description/Comment	Assessment/Implication
		instrument analytical run summaries; thus, they can be associated to field samples, and field samples can be qualified as needed. Batching is summarized in the MWH EDD.
LCS Recovery Forms [a]	The laboratory control sample (LCS) Form requires the following items: Lab Name, SDG No., LCS Source, True and Found Concentrations, percent recovery (%R), and acceptance limits. The LCSs (also referred to as fortified blanks or blank spikes) were prepared with all the acids used to digest the samples prepared with a given batch; however, as with the blanks above, the blank spikes were not digested. The UIASL blank spikes were prepared and analyzed at a rate or frequency of 10% of samples.	The Lab Name and SDG No. are documented on the preparation forms. The %Rs are documented on the COAs and the MWH EDD. The acceptance limits are specified in the SOPs. The True Concentrations are document in the raw data. The UIASL blank spikes are not true LCS since they were not digested. This represents uncertainty with respect to controlling the batch based on a prepared, clean-laboratory spike (also note that the ICP blank was spiked with all target analytes but the recovery of only cadmium was calculated and reported). However, completeness of digestion and documentation of acceptable recoveries on representative matrix can be evaluated using the SRM data.
MS/MSD Forms [a]	UIASL analyzed triplicates and MS instead of MS/MSD. MS/MSD Form requires Lab Name, SDG No., Matrix, % Solids; Control Limit, Spiked Sample Result, Sample Result, and Spike Added, and %R.	The Lab Name, SDG No., Matrix, Spiked Sample Result, and Spiked Result are documented on the preparation forms. % Solids (moisture content) is documented on the COA. The %Rs are documented on the COAs. The Spike Added, Control Limits, and %Rs are documented in the MWH EDD. Control Limits for MSs are not specified in the SOPs or other laboratory documentation; lack of a specified acceptance criterion does not preclude establishing a validation criterion for qualification of associated data. The spike concentrations are near the median detected concentration of the samples, so are representative of the sample media.
Analytical Run Logs	Analytical run logs is a time sequence of the analysis of laboratory instrument QC samples (calibration and instrument blanks) and prepared ("prep") samples	UIASL batch sheets provide information on the prep batch and laboratory instrument QC samples. The raw data packages include a

Content Item	Description/Comment	Assessment/Implication
	(field samples and batch QC samples).	summary of the analytical run sequence. The "Ref." on the COA contains date and time information, which is not the analytical run time, but rather the date/time the instrument data were uploaded to the laboratory's information management system (LIMS). The analytical dates/times for all calibration, laboratory QC samples, and field samples are recorded on the raw data and are documented on the MWH EDD.
Initial and Continuing Calibration and Calibration Blanks	Selenium by VGICP: The laboratory procedure was as follows: • Correlation coefficient (r) was determined from a three-point calibration (blank, 50, and 300 µg/L). • The r value was recorded on the raw instrument data. • Laboratory used an acceptance limit of $r \geq 0.995$. • Initial calibration was rerun if $r < 0.995$. • If $r \geq 0.995$, then a calibration factor determined from the linear regression was used to determine sample concentration based on instrument response. Heavy metals by ICP: For samples analyzed between 2 December 1999 and 15 February 2000, the ICP software did not automatically record the initial calibration correlation coefficient on the raw data. The laboratory procedure was as follows: • A two-point calibration was established per Section VI.I of SOP SMM.52.0101.01 (blank and 1-5 □g/L (depending on metal). • A slope and intercept were calculated but were not recorded on the raw instrument data. • Instrument responses and reported concentrations can be used to verify a recalculated slope and intercept. For samples analyzed between 13 December 2000 and 24 January 2001,	The results of instrument calibration and instrument blanks are documented in the raw data.

Content Item	Description/Comment	Assessment/Implication
	the ICP software automatically recorded the initial calibration correlation coefficient on the raw data. The laboratory procedure was as follows: • A three-point calibration was established using a blank, and 0.2, and 2 or 20 mg/L standards (depending on analyte). • Laboratory used an acceptance criterion of $r \geq 0.995$. • Initial calibration was rerun if $r < 0.995$. The laboratory analyzed a blank to establish initial calibration. Reagent (or instrument) blanks were prepared with all the acids used to digest the samples prepared with a given batch. Reagent blanks were prepared and analyzed at a frequency of 10% of samples.	
Initial Calibration Verification	ICV are instrument standards that are analyzed subsequent to the initial calibration. These standards are commonly prepared from a traceable reference material that is from a different source ("second source") as that used to establish the standards used in the initial calibration. The UIASL SOPs do not specify ICV, and ICVs were not analyzed.	An ICV from a second source provides data that ensures that the standards used for the initial calibration were prepared correctly or otherwise compromised. As such, the lack of a second-source standard to verify the initial calibration may mean that the calculated sample concentrations are inaccurate. However, UIASL analyzes SRM, and the SRM are within control limits for accuracy, which provides assurance that the initial calibration standards have not been compromised.
Continuing Calibration Verification	The laboratory analyzed a blank and mid- and high-level concentration to establish daily initial calibration. Laboratory QC samples labeled "check standard" are continuing calibration verification standards analyzed at approximately 10% frequency.	A correlation coefficient for the daily initial calibration is documented in the raw data packages. The %Rs for the check standards (or CCVs) are documented in the laboratory sheets titled "Quality Control" and on the COAs and are summarized in the MWH EDD. Acceptance criteria are not specified in the SOPs or other laboratory documentation; lack of a specified acceptance criterion does not preclude establishing a validation criterion for qualification of associated data.
ICP Interface Check Sample Recoveries	An interference check standard (ICS) is a standard that contains known concentrations of interfering elements that will provide an adequate test of the	VGICP: Per Dr, McGeehan, "Given that the chemistry of the hydride formation is highly selective for Se, I don't see this as a limitation of the

Content Item	Description/Comment	Assessment/Implication
	correction factors used to address spectral interferences. The UIASL does not specify ICS in the SOPs, and ICSs were not analyzed. The VGICP used at the time of analysis of the 1999-2000 was dedicated to selenium analysis, and did not incorporate interelement correction equations; however, output provided for negative values. The ICP instruments used at the time of analysis of the 1999-2000 elk study incorporated interelement correction equations and output provided for negative values.	validity of the data. The only significant interference for Se by hydride that I'm aware of is As." (McGeehan, 2009a).[b] ICP: Per Section 4.2.10 of EPA Method 6010C, "When interelement correction is not used, verification of absence of interference is required," and per Section 7.8, "If the particular instrument will display overcorrection as a negative number, this spiking procedure will not be necessary." Thus, the absence of ICSs does not impact data quality.
Matrix Duplicate	For each preparation batch, one field sample was selected for triplicate preparation and analysis.	Results are reported on COAs and summarized in the MWH EDD. Control Limits for replicates are not specified in the SOPs or other laboratory documentation; lack of a specified acceptance criterion does not preclude establishing a validation criterion for qualification of associated data.
Serial Dilution % Differences	A serial dilution is typically performed if the results of MS/MSD are not within control limits. If serial dilution analysis is performed as a result of failing MS/MSD, and does not pass acceptance criterion, then a sample matrix effect for affected target analytes is established. The UIASL SOPs do not specify serial dilution samples and serial dilution samples were not analyzed.	The absence of serial dilution does not preclude qualification of associated field samples based on failing MS/MSD. In the case of elk data, if MS/MSD %R are outside Functional Guideline control limits, and post-digestion spike sample results are not available, associated field results could be flagged based on MS/MSD %Rs.
Low-level Standard Check	The above referenced "check standard," the CCV are functionally low-level check standards because they were spiked at concentrations approximately 10 times the estimated detection limit (EDL).	Results are reported on COAs and summarized in the MWH EDD. Control Limits for check standards are not specified in the SOPs or other laboratory documentation; lack of a specified acceptance criterion does not preclude establishing a validation criterion for qualification of associated data.
MDLs and PQLs or RLs	In 1999-2000, UIASL reported EDLs, which are equivalent to instrument detection levels. MDLs were not developed for tissue samples until 2000. The EDLs are less than approximately 1 to 2 orders of magnitude of the concentrations spiked in the check standards. In 2000, the laboratory reported an MDL of 0.01 µg/g for	EDLs were used in 1999 and MDLs were established for sample analyzed in 2001. The implication of using instrument detection levels could be evaluated at Step 4 of the data assessment process (see additional discussion in Section 3.2 of this Tech Memo).

Content Item	Description/Comment	Assessment/Implication
	selenium and 0.025 µg/g for cadmium.	
SRM	UIASL analyzed in-house standard reference material (SRM), identified as "House Reference Liver" (or HRL) on COAs and laboratory raw data, in triplicate per preparation batch. HRL was an in-house developed SRM. Spike recovered amounts and control limits are specified on the "Quality Control" forms. HRLs are spiked at approximately 100 times the EDL. Also, when commercially available, UIASL also analyzed TORT samples, which are externally-supplied (outside vendor) SRMs.[c]	The HRLs are spiked at the following concentrations: Se – 0.446 ppm Mo – 3.17 ppm Zn – 120 ppm Cd – 54.3 ppm Pb – 48.0 ppm Mn – 10.1 ppm Fe – 183 ppm Cu – 123 ppm The spike amounts for Se, Mo, Zn, Mn, Fe, and Cu were approximately at the detected concentrations in the field samples. The spike amounts for Cd and Pb were 100 times the detected concentrations in the field samples.

[a] Required items such as Contract, Lab Code, Case No., NRAS No, and other CLP-specific coding are USEPA-CLP specific items that are not necessary if work is not performed for CLP so are not listed here.

[b] Spectral and matrix interferences are rare because selenium is volatilized and separated from the sample matrix prior to analysis (thus the material that is analyzed contains little that would interfere with selenium). Arsenic is the only known interferant in the measurement of selenium by ICP hydride. The interference from arsenic is physical rather than spectral. The physical interference is from hydride-formation, which can suppress the signal, resulting in potentially biased low results for selenium. This phenomenon would occur only in the presence of relatively high concentrations of arsenic (Mindak et al, 1999). During the period when the elk tissues were analyzed, arsenic was not spiked in the HRL. However, in subsequent years, the HRL was spiked with arsenic at concentration of 48 µg/g, and UIASL routinely runs other SRM (NRC-TORT) which contains 21 µg/g arsenic. UIALS has documented no interference problem with selenium recovery using either of these reference materials.

[c] Preparation of HRL: bovine liver was obtained from the Washington State University School of Veterinary Sciences. A large quantity of the liver was lyophilized, completely homogenized, and spiked with the analytes of interest. Spike concentrations were based on normal and elevated values observed in liver samples analyzed as part of our Veterinary Toxicology program over a 10 year period. The spiked liver samples were thorough homogenized again and analyzed on a properly calibrated instrument. Acceptance ranges (plus or minus 2 standard deviations) were based on a minimum of 10 replicates.

The following summarizes the deficiencies or non-standard laboratory practices that contribute to uncertainty with respect to the quality of the elk tissue data:

- A subset of chain-of-custody documents did not have "Relinquished By" and/or "Received By" signature(s).
- Laboratory data packages were not assembled with a table of contents and pagination.
- Laboratory blanks and fortified blanks (or LCSs) were not processed through the exact same procedure as the field and other laboratory QC samples. The exception is that they were not digested.

- MDLs were not established for the samples prepared, analyzed, and reported in 1999. Rather, those data were reported with UIASL EDLs (i.e., instrument detection limits).

- The laboratory did not provide an analytical run log summary.

- There was an instrument error in acquisition run date and time of analysis for samples in batch HMICP_12-28-99 (reported in ENV99-01). The raw data contains the wrong date and time of analysis (the actual date of analysis is 2/24/00; actual times are unknown).

- UIASL did not have established control limits for matrix spike samples.

- The concentration of cadmium and lead in the UIASL House Reference Liver were approximately 100 times greater than the concentrations detected in the field samples.

- UIASL no longer retains the documentation of (a) the prepared HRL used, or (b) the MDL study data obtained during the period that the elk tissue samples were analyzed.

3.2 Addressing A/T General Observation for Samples with Non-Standard Matrices

The A/T requested P4/MWH to address the following concern regarding nonstandard matrices prior to working through the first step of the assessment:

> The biota matrix extraction/digestion information for all labs needs further evaluation. P4 should evaluate the biota sample extraction/digestion preparation procedures and the associated QC to determine if data validation is possible. This is needed to ensure that the recovery of the compounds of concern was appropriate (for example, was there sufficient extraction/digestion from the site sample into the solvent media that is run through the instrument). With nonstandard matrices, it is quite common that the compounds/analytes of concern are not sufficiently recovered into the sample that is being measured. As a result, the instrument's output may meet the project/laboratory QC criteria but the final result is not representative of the site sample.

P4 has evaluated the extraction/digestion preparation procedure and associated QC samples and has determined that data validation is possible. The following laboratory SOPs (provided as Attachment B) specify detailed information on preparing and digesting tissue samples:

- UIASL SOP SMM.52.080.05: Total Selenium in Biological Tissue by Vapor Generation ICP (VGICP)

- UIASL SOP SMM.52.010.01: Heavy Metals in biological Tissue by ICP

The preparation log sheets for each method follow one-to-one the preparation steps listed in Sections V (Sample Preparation) of both SOPs. Using selenium analysis by VGICP as an example, the SRM were spiked at 100 times the EDL (or 0.5 µg/g compared to the EDL of 0.005 µg/g). The

SRM spike level is similar to the lower range of detection of selenium in one randomly selected batch (laboratory samples E9901907 through E9901924 for elk liver) of 0.26 to 4.7 µg/g (none in this batch were not detected). There are a sufficient number of SRM results to evaluate statistically to establish an after-the-fact level of detection for biota. This analysis could be performed during Step 4 of the assessment.

The current Director of UIASL, Steven McGeehan, Ph.D., responded to the A/T concern as follows:

> We analyze hundreds of these sample types each year as part of our Veterinary Toxicology program. We also collaborate with several other vet-tox labs across the country on Se methodology (including sample preparation, digestion, and instrumentation). I am quite confident in stating that the digestion preparation procedure was more than adequate to insure complete recovery of Se in the sample being measured (McGeehan, 2009b).

These inter-laboratory veterinary toxicology data could also be evaluated and presented at Step 4.

4.0 Addressing Next Steps to Complete an Assessment of the Pre-2004 Data

The section of the Roadmap titled "Next Steps to Complete an Assessment of the Pre-2004 Data" identified the following four steps for assessing the pre-2004 data:

1. Determine data needs
2. Screen data for use
3. Validate data
4. Document data quality

The first two steps are evaluated in Sections 4.1 and 4.2 of this Technical Memorandum.

4.1 Determine Data Needs

The intended use of the elk tissue data is to support the remedial investigation/feasibility study, including risk assessment and any informed risk management decisions by determining if past P4 mining activities are impacting human health by elk tissue consumption; to determine if elk are affected by past P4 mining activities, or if other ecological receptors are being affected by elk tissue concentrations (and thereby, P4's past mining activities). The elk tissue data represents one line of evidence and will be evaluated in conjunction with other lines of evidence (e.g., screening levels, action levels, and/or predicted concentrations based on soil or vegetation concentrations and standard exposure models) during the evaluations of human health and ecological risk assessments. Specifically, the 1999-2000 elk tissue data could be used as follows:

- Human Health Risk Assessment: The elk tissue data could be used in a qualitative and/or quantitative evaluation of human health risks in a baseline human health risk assessment. Specifically, concentrations of trace metals, including cadmium and selenium, in elk liver and muscle tissue could be used to model hypothetical exposures in humans who consume elk harvested from areas in and around P4's Ballard, Henry, and Enoch Valley mines. Modeled

exposure doses of trace metals in humans through elk tissue consumption could be compared to non-cancer reference doses (RfDs) to calculate non-cancer hazard quotients (HQs). Calculated HQs could be compared to EPA's acceptable HQ criterion of 1 to evaluate whether predictive human health exposures based on elk tissue data exceed the generally accepted human health hazard criteria. Conclusions regarding potential human health risks associated with the consumption of elk tissues harvested from the vicinity of P4's Ballard, Henry, and Enoch Valley mines will be based on multiple lines of evidence potentially including, but not limited to, comparison of elk tissue concentrations to screening levels, action levels, and/or predicted concentrations based on soil or vegetation concentrations and standard exposure models. Conclusions drawn from multiple lines of evidence in the human health risk assessment will be used in risk management decisions regarding the mines.

- Ecological Risk Assessment: The elk tissue data could be used in a qualitative evaluation of ecological risks in a screening-level ecological risk assessment. Specifically, concentrations of trace metals, including cadmium and selenium, in elk liver and muscle tissue could be compared to published concentrations of these trace metals in the tissue of similar organisms (e.g., wild ungulates or livestock) that represent a no-observable-adverse-effect-level (NOAEL) or a lowest-observable-adverse-effect-level (LOAEL). If concentrations of trace metals in elk liver or muscle tissue exceed LOAEL concentrations of these trace metals in such organisms, then it could be concluded that there is a potential for ecological risks to ungulates, including elk, associated with foraging on P4's Ballard, Henry, and Enoch Valley mines. Such conclusions will be based on multiple lines of evidence potentially including, but not limited to, comparison of measured elk tissue concentrations to tissue-based screening levels, action levels and/or tissue concentration measured in livestock (e.g., horses, cattle, sheep) associated with poisoning episodes within the Southeast Idaho Phosphate Resource Area. Conclusions drawn from multiple lines of evidence in the ecological risk assessment will be used in risk management decisions regarding the mines.

Data needs were determined using systematic planning using the EPA DQO process (EPA QA/G4 guidance, data quality objectives process). In this case, the DQO's are used to guide decisions on whether existing data are of the appropriate type and quality to support specific intended uses (risk assessment, site characterization, data gap analysis, or scoping).

Table 2. Elk Tissue Data Quality Objectives

Step 1 -State the Problem	Levels of targeted trace elements may be elevated in elk tissue as a result of increased exposures related to phosphate mining. The quantified threat to human health or the environment, if any, is not well defined.
Step 2 – Identify the Goals of the Study	Principal Study Question 1 (PSQ1): Are sufficient elk tissue COPC concentrations data available to characterize the nature and extent of trace mineral exposures in large mammals (e.g., ungulates) foraging within the Southeast Idaho Phosphate Resource Area, in support of P4 RI/FS activities? Alternative actions: 1. No action. Existing data are of adequate quality and quantity to characterize trace

	mineral exposures to ungulates associated with phosphate mining within the Southeast Idaho Phosphate Resource Area. 2. Collect elk tissue data to provide additional COPC and spatial coverage. Decision statement: Decide whether sufficient data (number of elk tissue samples and spatial coverage) are available to adequately characterize the nature and extent of elk tissue contamination at potential source areas. Principal Study Question 2 (PSQ2): Are data sufficient to determine if risk-based screening levels and/or action levels for human health and ecological receptors are exceeded within portions of the Southeast Idaho Phosphate Resource Area impacted by phosphate mining, including the P4 mines? Alternative actions: 1. No action. Elk tissue data are sufficient and risk screening indicates that COPC's do not pose a risk. 2. Some COPC concentrations exceed risk-based screen levels; carry COPCs that exceed screening levels into a baseline RA. Decision statement: Decide what additional elk tissue data are needed so that comparisons can be made to appropriate human health and/or ecological screening levels. Principal Study Question 3 (PSQ3): Are elk tissue data sample numbers and coverage sufficient to support analyses in the baseline human health risk assessment (RA) and feasibility study (FS) (for example, were elk harvested in portions of the Southeast Idaho Phosphate Resource Area impacted by phosphate mining that could result in human health risk if consumed? Alternative actions: 1. No action. Existing data are of adequate quality and coverage to conduct a baseline RA for the P4 mines. 2. Collect additional elk tissue data to provide supporting data for RA and FS analyses. Decision statement: Decide whether sufficient tissue COPC and coverage data are available to support baseline RA and FS studies and collect additional data, as needed.
Step 3 – Identify Information Inputs	The information inputs for the decision process includes that following items that may exist or will need to be collected – • list of COPCs • conceptual site models • sample location maps (spatial coverage of existing data) • laboratory quality information

	• risk-based screening benchmarks for COPCs • elk tissue COPC data (existing; use of existing data will be dependent upon evaluations of data usability and data validation)
Step 4 – Define the Boundaries of the Study	Spatial boundaries: • Spatial delineation of all existing harvest locations: • • Elk harvested from Game Management Units 66A and 76, including potentially impacted and non-impacted elk, during the cooperative elk study performed by the Selenium Committee and IDFG. Temporal boundary: • Existing tissue data from elk hunting seasons in 1999 and 2000.
Step 5 – Develop the Analytic Approach	If available data are suitable to characterize COPC nature and extent, and to provide a reliable estimate of elk tissue concentrations, then additional data will not be collected. Otherwise the data will be considered incomplete for characterization. (PSQ1) If elk tissue COPC concentrations exceed risk-based screening levels during initial risk screening, then the COPC will be carried forward for risk assessment. Otherwise the COPC will be dropped (note that evaluation of cumulative risk may require consideration of COPCs that have been eliminated under discrete assessment). (PSQ2) Additional elk tissue collection will be conducted, or additional targeted sampling may need to be conducted, based on results of the baseline RA and other lines of evidence. (PSQ3)
Step 6 – Specify Acceptance Criteria	Data will be validated to the extent possible, with any qualifiers assigned. Use of data will be limited to the restrictions of qualifiers, if any.
Step 7 – Develop the Plan for Existing Data	Existing elk tissue data will be evaluated for quality and intended final use by reviewing laboratory quality data and risk assessment needs. Validation will proceed upon A/T acceptance of quality evaluation and intended final use.

4.2 Screen Data for Use

This section presents the screening assessment as outlined in as Step 2 of the Roadmap.

As suggested in the Roadmap:

> This screening/assessment can be documented in a report consisting of introductory text, a summary table, and review worksheets. The summary table should contain the following information:
>
> - Pre-2004 data episode
> - Analytical laboratory

- Matrix
- Target analytes
- Detection limits
- Action levels
- Description of spatial coverage
- Other relevant comments or notes on the parameters per the DQOs
- A final column indicating whether the data passes for the next step of the assessment

The technical memorandum provides the introduction and the summary table is provided as Table 3. Instead of providing review worksheets, the analytical data, including preparation and analytical batching information, are consolidated in the MWH EDD provided as Attachment A.

Table 3. Screening Summary for the 1999-2000 Elk Tissue Data

<table>
<tr><td>Pre-2004 Data Episode:</td><td>1999-2000 Elk Liver and Muscle Tissue</td></tr>
<tr><td>Analytical Laboratory:</td><td>University of Idaho Analytical Sciences Laboratory (UIASL)
Holm Research Center
Moscow, ID 83844-2203
(208) 885-7900
Point of Contact: Janet Snow (jsnow@uidaho.edu) 208/885-5809
Laboratory Director: Steven McGeehan, Ph.D.</td></tr>
<tr><td>Matrix:</td><td>Biota (muscle and liver tissue)</td></tr>
<tr><td>Target Analytes and Detection Limits:</td><td>
<table>
<tr><th>Analyte</th><th>EDL, µg/g (wet wt)</th><th>Instrument</th><th>UIASL SOP</th></tr>
<tr><td>Selenium</td><td>0.005</td><td>VG ICP</td><td>SMM.52.080.05</td></tr>
<tr><td>Molybdenum</td><td>0.09</td><td>ICP</td><td>SMM.52.010.01</td></tr>
<tr><td>Zinc</td><td>0.01</td><td>ICP</td><td>SMM.52.010.01</td></tr>
<tr><td>Cadmium</td><td>0.02</td><td>ICP</td><td>SMM.52.010.01</td></tr>
<tr><td>Lead</td><td>0.23</td><td>ICP</td><td>SMM.52.010.01</td></tr>
<tr><td>Manganese</td><td>0.01</td><td>ICP</td><td>SMM.52.010.01</td></tr>
<tr><td>Iron</td><td>0.04</td><td>ICP</td><td>SMM.52.010.01</td></tr>
<tr><td>Copper</td><td>0.03</td><td>ICP</td><td>SMM.52.010.01</td></tr>
</table>
EDL - estimated detection limit
VGICP - Vapor Generation ICP
ICP - Inductively Coupled Plasma Atomic Emission Spectrometer</td></tr>
<tr><td>Analytical Package Summary:</td><td>
<table>
<tr><th>UIASL Case #</th><th>UIASL Sample ID Ranges</th></tr>
<tr><td>ENV99-01</td><td>E9901644 through E9901850</td></tr>
<tr><td>ENV99-03</td><td>E9901891 through E9902009</td></tr>
<tr><td>EOT00-04</td><td>E0001553 through E0001620</td></tr>
<tr><td>ENV00-01</td><td>E0001643 through E0001728</td></tr>
<tr><td>ENV00-04</td><td>E0001771 through E0001812</td></tr>
<tr><td>ENC00-01</td><td>E0001845 through E0001848</td></tr>
</table></td></tr>
<tr><td>Action Levels:</td><td>None were designated in the 1999 Interim Investigation Data Report, Southeast Idaho Phosphate Resource Are Selenium Project (MWH, 2000). However, available risk-based values protective of human health consumption of harvested deer as derived by the Texas Department of State Health Services, and measured concentrations of trace minerals in deer harvested from impacted and non-impacted areas of Texas, Louisiana and Oklahoma have been compiled (refer to Attachment C). As indicated in Attachment C, with one exception for lead, the EDLs and MDLs for the eight primary trace minerals are</td></tr>
</table>

	below available risk-based values for ungulates (e.g., deer) published by the Texas Department of State Health Services (2006), as well as measured concentrations in muscle and liver tissue samples in deer harvested from the Caddo Lake NWR, Texas. The Baseline Mineral Content in Dear for lead in kidney tissue is 0.10 to 0.90 mg/kg; whereas, the EDL and MDL for lead (0.23 and 0.50 mg/kg, respectively) are greater than the lower range. In regard to future risk screening, no-observable-adverse-effect-levels and low-observable-adverse-effect-levels will be used for human health and ecological risk screening.
Description of Spatial Coverage:	Game Management Units 66A and 76. Unit 66A—Those portions of Bonneville and Caribou counties within the following boundary: beginning on the McCoy Creek Road (Forest Service Road 087) at the Idaho-Wyoming State line, west on McCoy Creek Road through Herman to the Bone Road, then south on the Bone Road to State Highway 34, then east on State Highway 34 to the state line, then north along the state line to the point of beginning. Unit 76—Those portions of Bear Lake and Caribou counties within the following boundary: beginning at U.S. 89 on the Idaho-Utah State line, then north to Montpelier, then north on U.S. 30 to Soda Springs, then northeast on State Highway 34 to the Idaho-Wyoming State line, then south on the Idaho-Wyoming State line to the Idaho-Utah State line, then west on the Idaho-Utah State line to U.S. 89, the point of beginning.
Spatial Relevance:	Reference: 1999 Interim Investigation Data Report, Southeast Idaho Phosphate Resource Area Selenium Project (MWH, 2000). As indicated in the reference document, IDFG determined a home range for elk of approximately 600 square miles (equivalent to the area of all mines plus 10 miles from any mine boundary). For purposes of data collection, tissue samples from elk harvested further than 10 miles from any phosphate mine boundary were designated as control samples, listed in Table 4-7 of the report as "before-the-fact treatment" control samples ("treatment" referring to statistical treatment). Tissue samples collected from elk harvested within 10 miles of any mine boundary were designated as mine samples, listed in Table 4-7 of the report as "before-the-fact treatment" mine samples. The data were then statistically evaluated, and reclassified as "after-the-fact treatment" control or mine samples, as listed in Table 4-7 of the report. The elk tissue data collected in 2000 were not presented in a published report; however, they were statistically evaluated and reclassified as "after-the-fact treatment" control or mine samples in the same manner as the 1999 elk tissue data. In summary, a 10-mile radius was not arbitrarily applied to categorize elk tissue samples as control or mine-related. Additional details regarding determination of the elk tissue study area are as follows: • In the baseline elk study conducted by the IDFG in the late 1970s and early 1980s (Kuck 1984a, 1984b), home ranges for elk were best described as "elliptical polygons." Kuck (1984a, 1984b) reported

	substantial variation between individuals and years. However, the median year-around home range for elk was reported as 26 square miles, with a mean migration distance between summer and winter range of 4.1 miles. • The Selenium Committee used this IDFG information to initially classify any elk harvested at a distance of 10 or more miles from any phosphate mine as controls. This distance was derived as follows from the information provided by Kuck (1984a, 1984b): the 26 square mile home range was assumed to be circular with a resulting diameter of 5.8 miles, and the average migration distance of 4.1 miles was added to the diameter to obtain a distance of 9.9 miles; this value was rounded up to 10 miles. It was assumed that any elk killed at this or greater distance from any phosphate mine is likely to have never been substantially exposed to seleniferous forage grown on phosphate waste rock dumps. • In An Evaluation of the Effects of Selenium on Elk, Mule Deer, and Moose in Southeastern Idaho, Kuck (2003) reported a median winter home range for elk equal to 5.5 square miles, and a median summer home range for elk equal to 10.6 square miles. The median year-round home range for elk was reported as 26 square miles. • Elk tissue samples harvested further than 10 miles from any phosphate mine boundary were designated as control samples, listed in Table 4-7 of the report as "before-the-fact treatment" control samples ("treatment" referring to statistical treatment). The data were then statistically evaluated, and reclassified as "after-the-fact treatment" control or mine samples, as listed in Table 4-7 of the report.
Indicate whether the data passes for the next step of the assessment:	Yes, all data should be process through Step 3 (data validation) of the Roadmap.

5.0 Path Forward

If the A/T concur with the assessments presented herein for Steps 1 and 2 (determine data needs and screen data for use), P4 will prepare data validation report templates for the VGICP and ICP methods. Once the templates are reviewed and approved, a third-party data validation firm will validate the data per the criteria documented on the templates and provide written reports and electronic flagged data for uploading to the P4 project database. P4 will then proceed with Step 4 (document data quality) of the Roadmap.

The following excerpts are extracted from EPA's 1992 Guidance for Data Usability in Risk Assessment (Part A) - Final:

- Data are almost always useable in the risk assessment process, as long as the uncertainty in the data and its impact on the risk assessment are thoroughly explained.

- The analytical data objective for baseline risk assessments is that uncertainty is known and acceptable, not that uncertainty be reduced to a particular level.
- Uncertainties in toxicological measures and exposure assessment are often assumed to be greater than uncertainties in environmental analytical data; thus, they are assumed to have a more significant effect on the uncertainty of the risk assessment.
- Sampling variability typically contributes much more to total error than analytical variability.
- Field methods can produce legally defensible data if appropriate method QC is available and if documentation is adequate.
- Qualified data can usually be used for quantitative risk assessment.
- Use data qualified as U or J for risk assessment purposes.
- The primary planning objective is that uncertainty levels are acceptable, known and quantifiable, not that uncertainty is eliminated.

Further, the EPA acknowledges in its guidance that uncertainties in the analytical data typically pale in comparison to uncertainties in other portions of the risk assessment, including the exposure assessment and toxicity information (Section 2.1.4, USEPA, 1992).

6.0 References

Kuck, L., ed. 1984a. Cooperative wildlife-phosphate study. Phase I: Baseline studies. Final Report. Idaho Department of Fish and Game, Boise.

Kuck, L., ed. 1984b. Cooperative wildlife-phosphate study. Phase II: Mining impacts studies. Idaho Department of Fish and Game, Boise.

Kuck, L. 2003. An Evaluation of Effects of Selenium on Elk, Mule Deer, and Moose in Southeastern Idaho, Prepared for MWH for the Idaho Mining Association Selenium Committee.

McGeehan, 2009a. Email communication from Steven McGeehan, Ph.D., Laboratory Director, University of Idaho Analytical Services Laboratory, to Ruth Siegmund, MWH. August 13.

McGeehan, 2009b. Email communication from Steven McGeehan, Ph.D., Laboratory Director, University of Idaho Analytical Services Laboratory, to Ruth Siegmund, MWH. July 30.

Mindak, W.R and S.P. Dolan, 1999. Determination of arsenic and selenium in food using a microwave digestion-dry ash preparation and flow injection hydride generation atomic absorption spectrometry. Journal of Food Composition and Analysis. 12:111-122.
Montgomery Watson (MW), 1999. *1999-2000 Regional Investigation Sampling and Analysis Plan, Southeast Idaho Phosphate Resource Area Selenium Project.* Prepared for the Idaho Mining Association Selenium Subcommittee. September.

MW, 2000. *1999 Interim Investigation Data Report, Southeast Idaho Phosphate Resource Area Selenium Project.* Idaho Mining Association Selenium Committee. October.

P4 Production and MWH, 2008. *Pre-2004 Documents and Data Review and Summary for the Historic P4 Production Phosphate Mines, Caribou County, Idaho.* Revision 2. December 8.

United States Environmental Protection Agency (USEPA), 1992. *Guidance for Data Usability in Risk Assessment (Part A).* Publication 9285.7-09A. Office of Emergency and Remedial Response, Washington D.C. April.

USEPA, 2002. *Guidance for Quality Assurance Project Plans. EPA QA/G-5.* Office of Environmental Information, Washington D.C. December.

ATTACHMENT A

MWH EDD – 1999-2000 Elk Tissue Data

ATTACHMENT A
MWH EDD - 1999-2000 ELK TISSUE DATA
SELENIUM BY ICP
(Page 1 of 16)

UISAMPLE	SUBSAMPLE	MATRIX	CAS #	ANALYTE	RESULTS	EDL	UNITS	Spike Amt	% REC	DATEREC	QCF	METHOD	UIASL Case #	Raw Data Batch	Prep Batch	EDD Name	Date Prep	Date Analyzed	Time Analyzed
E9901647S1	TORT-2	SRM	7782-49-2	Selenium	5.800	0.005	ug/g	5.63	103	11/2/1999	SR	ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1207
E9901647SR	House Ref. Liver	SRM	7782-49-2	Selenium	0.470	0.005	ug/g	0.446	105	11/2/1999	SR	ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1209
E9901647	101-9-007510	Liver	7782-49-2	Selenium	1.300	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1212
E9901647-2	101-9-007510	Liver	7782-49-2	Selenium	1.400	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1215
E9901647-3	101-9-007510	Liver	7782-49-2	Selenium	1.300	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1218
E9901647MS	101-9-007510-MS	MS	7782-49-2	Selenium	80		%			11/2/1999	MS	ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1221
E9901652	101-9-013229	Liver	7782-49-2	Selenium	5.500	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1224
E9901657	101-9-020457	Liver	7782-49-2	Selenium	1.200	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1227
E9901673	101-9-057366	Liver	7782-49-2	Selenium	3.500	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1230
E9901690	102-9-003525	Liver	7782-49-2	Selenium	0.310	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1233
E9901692	102-9-008730	Liver	7782-49-2	Selenium	2.400	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1236
E9901713	106-9-009470	Liver	7782-49-2	Selenium	0.780	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1239
E9901713D	106-9-009470	Liver	7782-49-2	Selenium	0.770	0.005	ug/g			11/2/1999	D	ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1241
E9901713B	Laboratory Blank	BLANK	7782-49-2	Selenium	BDL	0.005	ug/g			11/2/1999	B	ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1244
E9901713CS	Check Standard	CS	7782-49-2	Selenium	0.054	0.005	ug/g	0.05	108	11/2/1999	CS	ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1247
E9901713BS	Lab. Blank Spike	BS	7782-49-2	Selenium	103		%			11/2/1999	BS	ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1250
E9901713SR	House Ref. Liver	SRM	7782-49-2	Selenium	0.450	0.005	ug/g	0.446	101	11/2/1999	SR	ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1253
E9901715	107-9-001328	Liver	7782-49-2	Selenium	0.390	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1256
E9901718	107-9-008536	Liver	7782-49-2	Selenium	0.380	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1259
E9901722	108-9-004804	Liver	7782-49-2	Selenium	2.700	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1302
E9901745	101-9-007510	Muscle	7782-49-2	Selenium	0.110	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1305
E9901745-2	101-9-007510	Muscle	7782-49-2	Selenium	0.120	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1308
E9901745-3	101-9-007510	Muscle	7782-49-2	Selenium	0.130	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1311
E9901745MS	101-9-007510-MS	MS	7782-49-2	Selenium	113		%			11/2/1999	MS	ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1314
E9901752	101-9-013229	Muscle	7782-49-2	Selenium	0.400	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1316
E9901761	101-9-020457	Muscle	7782-49-2	Selenium	0.160	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1319
E9901761D	101-9-020457	Muscle	7782-49-2	Selenium	0.160	0.005	ug/g			11/2/1999	D	ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1322
E9901693	102-9-009184	Liver	7782-49-2	Selenium	1.100	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1325
E9901693B	Laboratory Blank	BLANK	7782-49-2	Selenium	BDL	0.005	ug/g			11/2/1999	B	ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1328
E9901693CS	Check Standard	CS	7782-49-2	Selenium	0.049	0.005	ug/g	0.05	98	11/2/1999	CS	ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1331
E9901693BS	Lab. Blank Spike	BS	7782-49-2	Selenium	98		%			11/2/1999	BS	ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1334
E9901693SR	House Ref. Liver	SRM	7782-49-2	Selenium	0.440	0.005	ug/g	0.446	99	11/2/1999	SR	ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1337
E9901693B1	Laboratory Blank	BLANK	7782-49-2	Selenium	BDL	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1340
E9901693C1	SEH1	CS	7782-49-2	Selenium	0.300	0.005	ug/g			11/2/1999	CS	ICP, Hydride	ENV99-01P	VGICP_11-29-99	1129semw	ENV9901P	11/22/1999	11/29/1999	1342
E9901776CS	SEH2	CS	7782-49-2	Selenium	0.051	0.005	ug/g	0.05	102	11/2/1999	CS	ICP, Hydride	ENV99-01P	VGICP_12-02-99	1202semw	ENV9901P	11/23/1999	12/2/1999	1229
E9901776SR	House Ref. Liver	SRM	7782-49-2	Selenium	0.440	0.005	ug/g	0.446	99	11/2/1999	SR	ICP, Hydride	ENV99-01P	VGICP_12-02-99	1202semw	ENV9901P	11/23/1999	12/2/1999	1232
E9901776	101-9-057366	Muscle	7782-49-2	Selenium	0.190	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_12-02-99	1202semw	ENV9901P	11/23/1999	12/2/1999	1402
E9901801	102-9-003525	Muscle	7782-49-2	Selenium	0.120	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_12-02-99	1202semw	ENV9901P	11/23/1999	12/2/1999	1405
E9901805	102-9-008730	Muscle	7782-49-2	Selenium	0.710	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_12-02-99	1202semw	ENV9901P	11/23/1999	12/2/1999	1408
E9901806	102-9-009184	Muscle	7782-49-2	Selenium	0.170	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_12-02-99	1202semw	ENV9901P	11/23/1999	12/2/1999	1411
E9901826	106-9-009470	Muscle	7782-49-2	Selenium	0.190	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_12-02-99	1202semw	ENV9901P	11/23/1999	12/2/1999	1414
E9901828	107-9-001328	Muscle	7782-49-2	Selenium	0.170	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_12-02-99	1202semw	ENV9901P	11/23/1999	12/2/1999	1419
E9901831	107-9-008536	Muscle	7782-49-2	Selenium	0.190	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-01P	VGICP_12-02-99	1202semw	ENV9901P	11/23/1999	12/2/1999	1421
E9901914	101-9-041577	Liver	7782-49-2	Selenium	2.800	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-03P	VGICP_12-02-99	1202semw	ENV9903P	11/23/1999	12/2/1999	1424
E9901929	101-9-069462	Liver	7782-49-2	Selenium	0.430	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-03P	VGICP_12-02-99	1202semw	ENV9903P	11/23/1999	12/2/1999	1427
E9901929D	101-9-069462	Liver	7782-49-2	Selenium	0.440	0.005	ug/g			11/2/1999	D	ICP, Hydride	ENV99-03P	VGICP_12-02-99	1202semw	ENV9903P	11/23/1999	12/2/1999	1430
E9901943	102-9-011973	Liver	7782-49-2	Selenium	0.320	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-03P	VGICP_12-02-99	1202semw	ENV9903P	11/23/1999	12/2/1999	1433
E9901943B	Laboratory Blank	BLANK	7782-49-2	Selenium	BDL	0.005	ug/g			11/2/1999	B	ICP, Hydride	ENV99-03P	VGICP_12-02-99	1202semw	ENV9903P	11/23/1999	12/2/1999	1435
E9901943CS	Check Standard	CS	7782-49-2	Selenium	0.053	0.005	ug/g	0.05	106	11/2/1999	CS	ICP, Hydride	ENV99-03P	VGICP_12-02-99	1202semw	ENV9903P	11/23/1999	12/2/1999	1441
E9901943SR	House Ref. Liver	SRM	7782-49-2	Selenium	0.410	0.005	ug/g	0.446	92	11/2/1999	SR	ICP, Hydride	ENV99-03P	VGICP_12-02-99	1202semw	ENV9903P	11/23/1999	12/2/1999	1444
E9901943-2	102-9-011973	Liver	7782-49-2	Selenium	0.330	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-03P	VGICP_12-02-99	1202semw	ENV9903P	11/23/1999	12/2/1999	1447
E9901943-3	102-9-011973	Liver	7782-49-2	Selenium	0.350	0.005	ug/g			11/2/1999		ICP, Hydride	ENV99-03P	VGICP_12-02-99	1202semw	ENV9903P	11/23/1999	12/2/1999	1450